Differences Between TOVS Path-A and Broadband Depictions of Tropical-Mean OLR Variability

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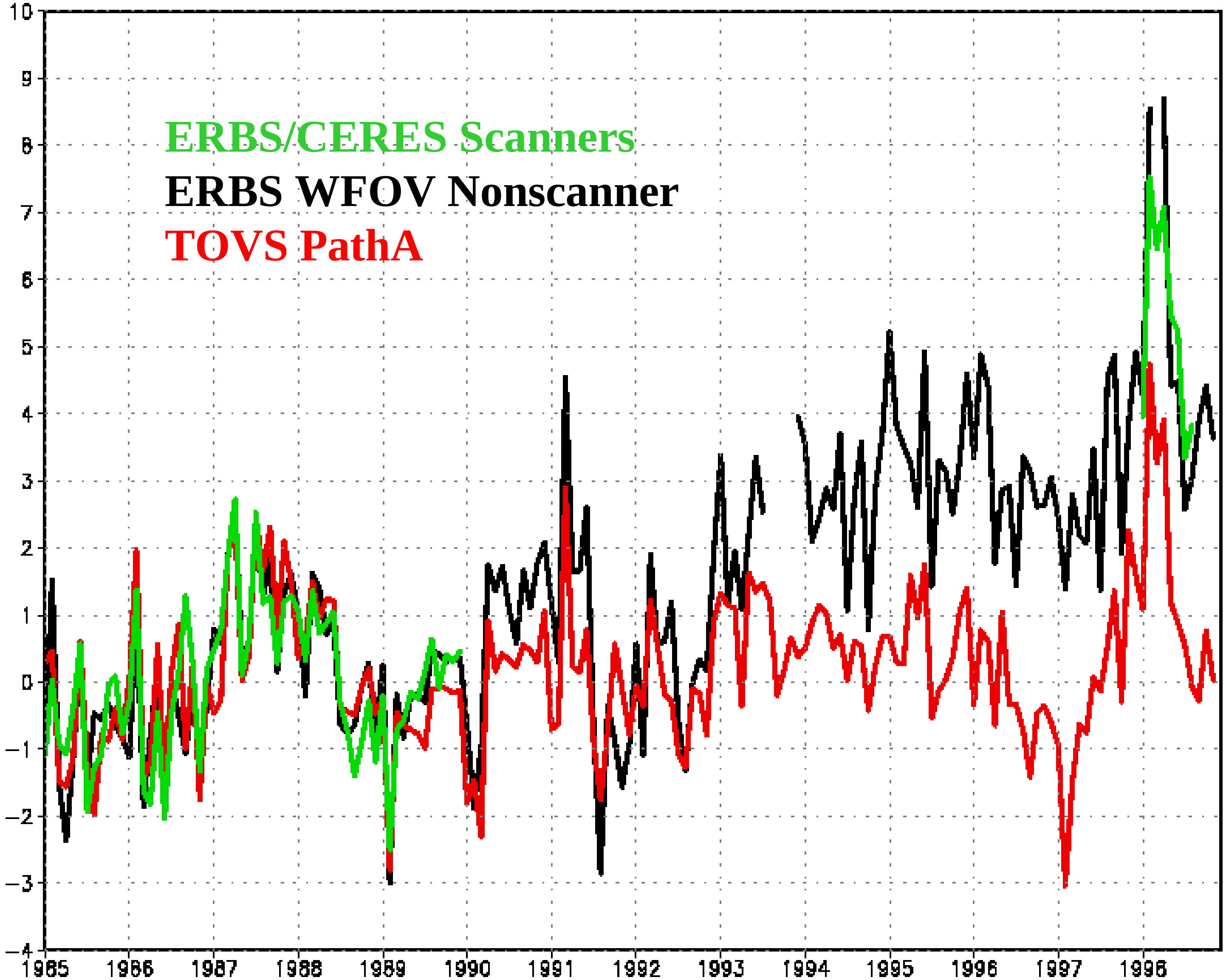
Can the TOVS data record delineate and quantify interannual signals in OLR, LWCS, and LWCF?

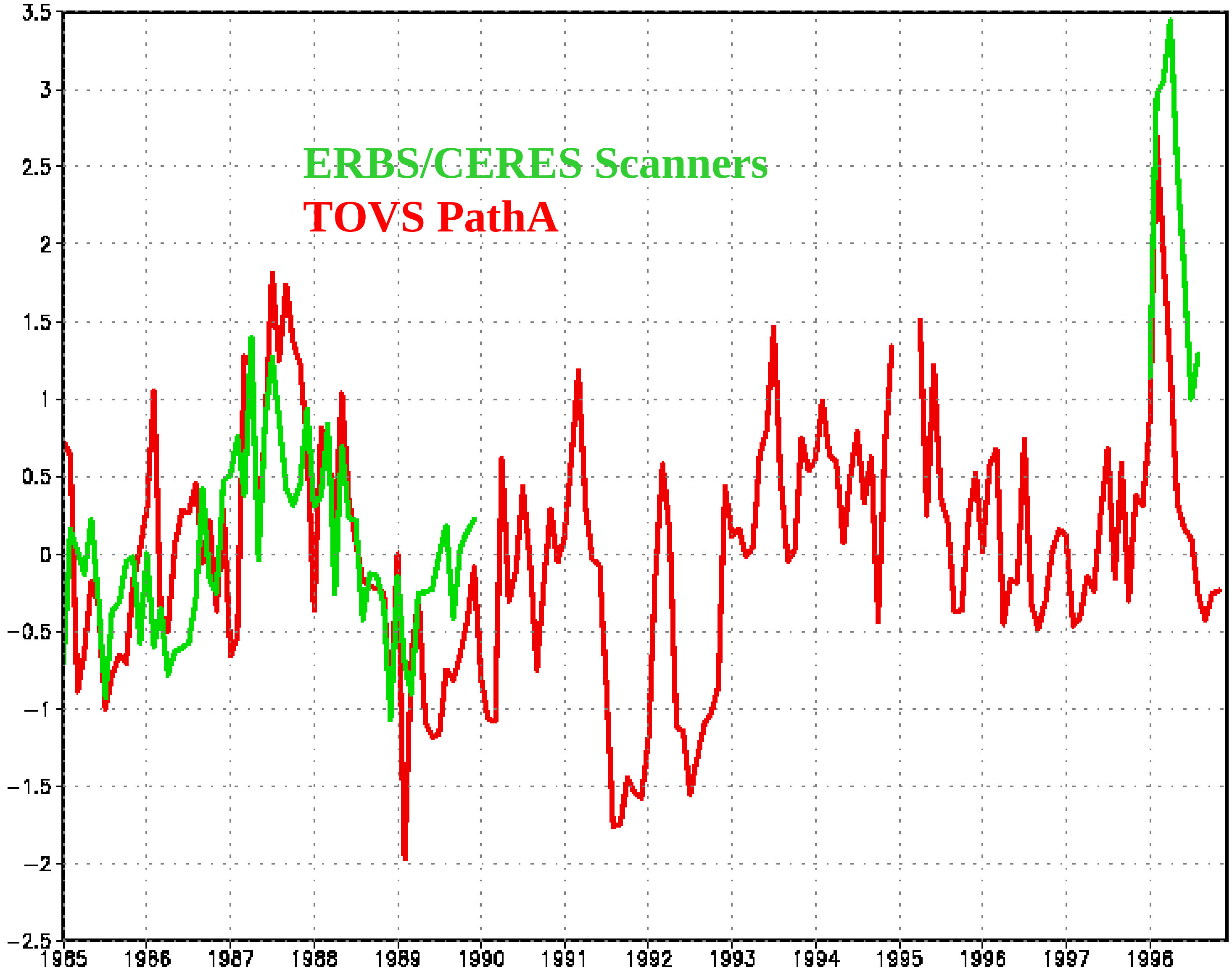
Why compare TOVS PathA to ERBS / CERES broadband OLR?

- NOAA satellites' temporal coverage bridges scanner measurements and (in contrast to non-scanner) provides spatial resolution that enables clear-sky / cloudy-sky partitioning.
- TOVS retrievals of water vapor, temp and cloud height vertical profiles may offer insight on physical processes responsible for interannual variability of OLR.
- Comparison of independent data sets typically useful in understanding measurement / retrieval errors.

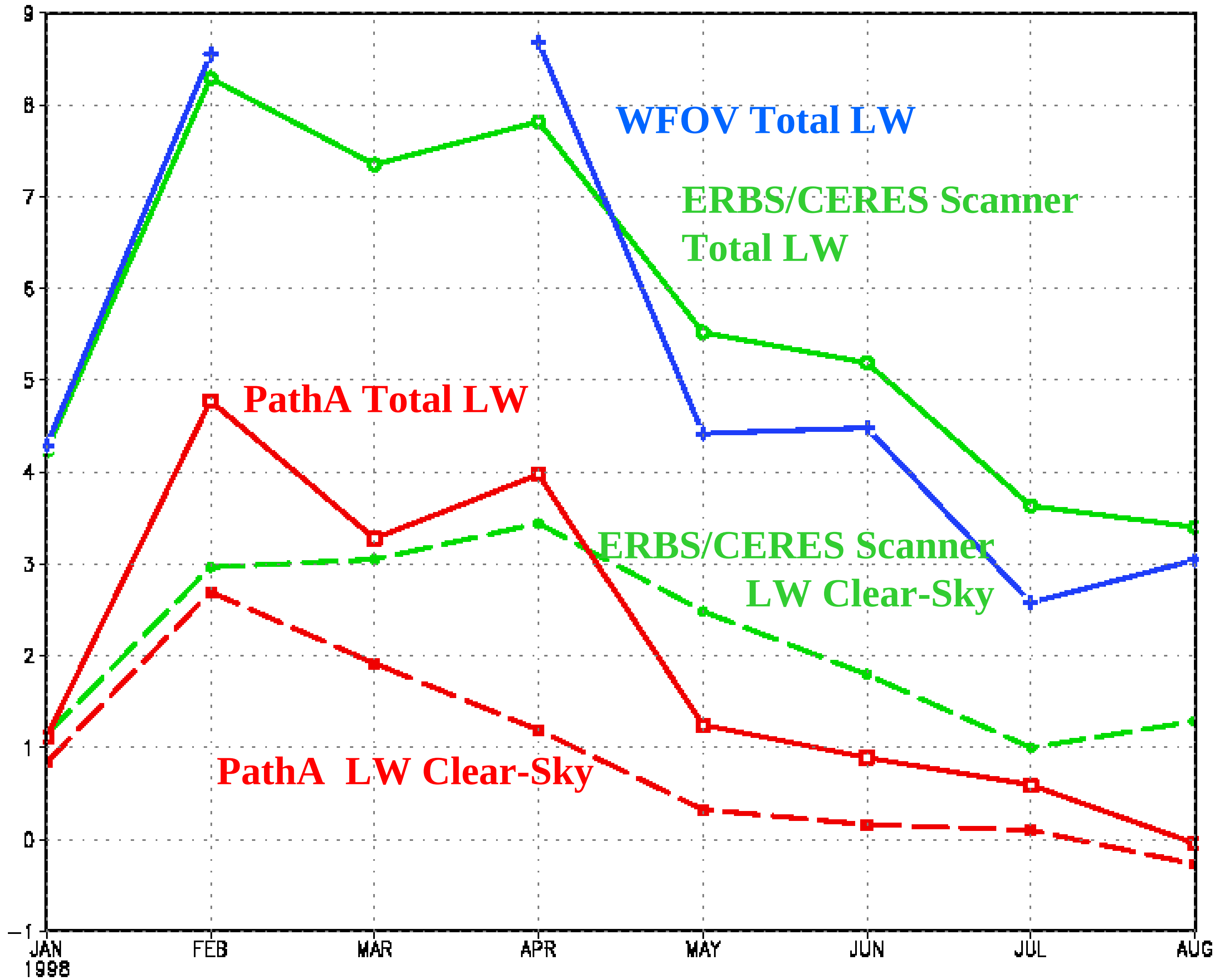
Tropical Mean ($20^oN/S$) OLR Anoms (Wm^{-2}) Relative to 1985/89



Tropical Mean (20°N/S) Clear-Sky OLR Anoms (Wm^{-2}) Rel to 1985/89



1998 OLR Flux Anomalies (Wm^{-2}) 20^{o}N/S Mean



Brief Outline of TOVS Pathfinder-A Methodology

TOVS PARTICULARS:

High resolution Infrared Radiation Sounder 2 (HIRS/2)

- atmospheric emission in seven 15.3 micron CO_2 channels
- atmospheric emission in five 4.3 micron CO_2 channels
- surface and H_2O emission in one 11.0 micron window channel
- surface and O_3 emission in one 9.6 micron window channel
- atmospheric emission in three 6.7 micron H_2O channels
- surface emission & reflected solar radiation in two 3.7 micron window channels

Microwave Sounding Unit (MSU)

- atmospheric emission in three 56 GHz O_2 channels
- surface emission in one 56 GHz window channel

IMPORTANT ATTRIBUTES / CAVEATS:

- Interactive 6 hour forecast-retrieval-analysis cycle using GEOS-I provides initial guess fields of temperature, humidity and geopotential thickness.

- Physical retrieval method based on the iterative relaxation technique (Chahine, 1968; Susskind et al.; 1984). Surface characteristics such as skin temperature, sea surface temperature and microwave emissivity are determined so as to be consistent with the radiances measured in the window channels.

- Once these are known, remaining geophysical parameters, namely the humidity profile, total O_3, cloudtop height and effective cloud amount, OLR are derived.

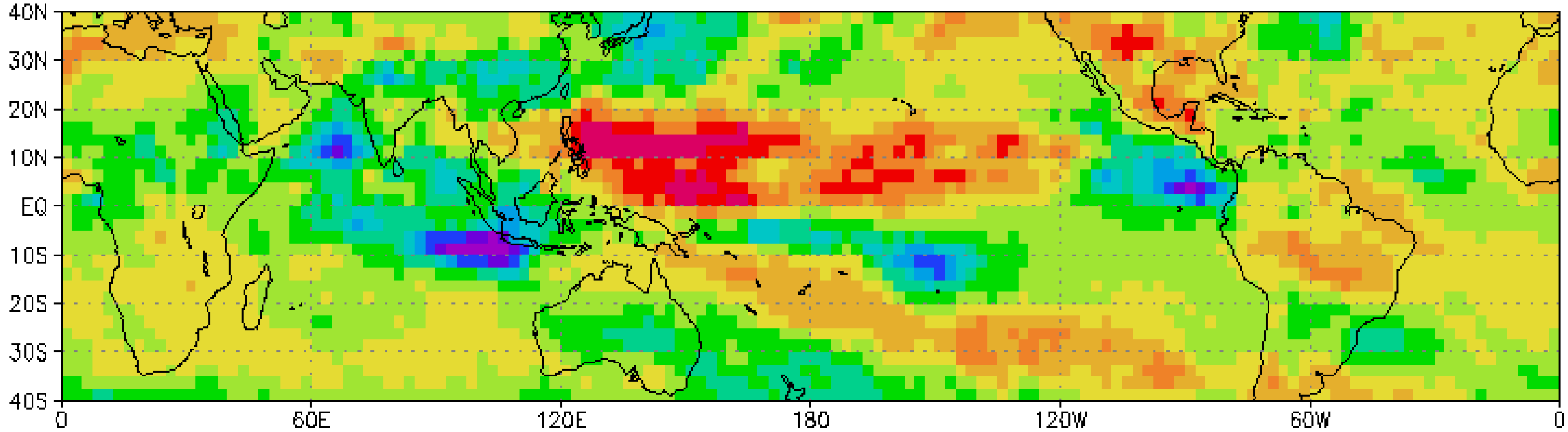
- Radiances calibrated to rawinsondes and TOMS O_3 every 48 hours, which accommodates instrument calibration uncertainties, 1st guess model local biases.

- In cases where scenes are too cloudy for inversions, 1st guess temp, moisture, TS are used, but cloud properties are STILL retrieved.

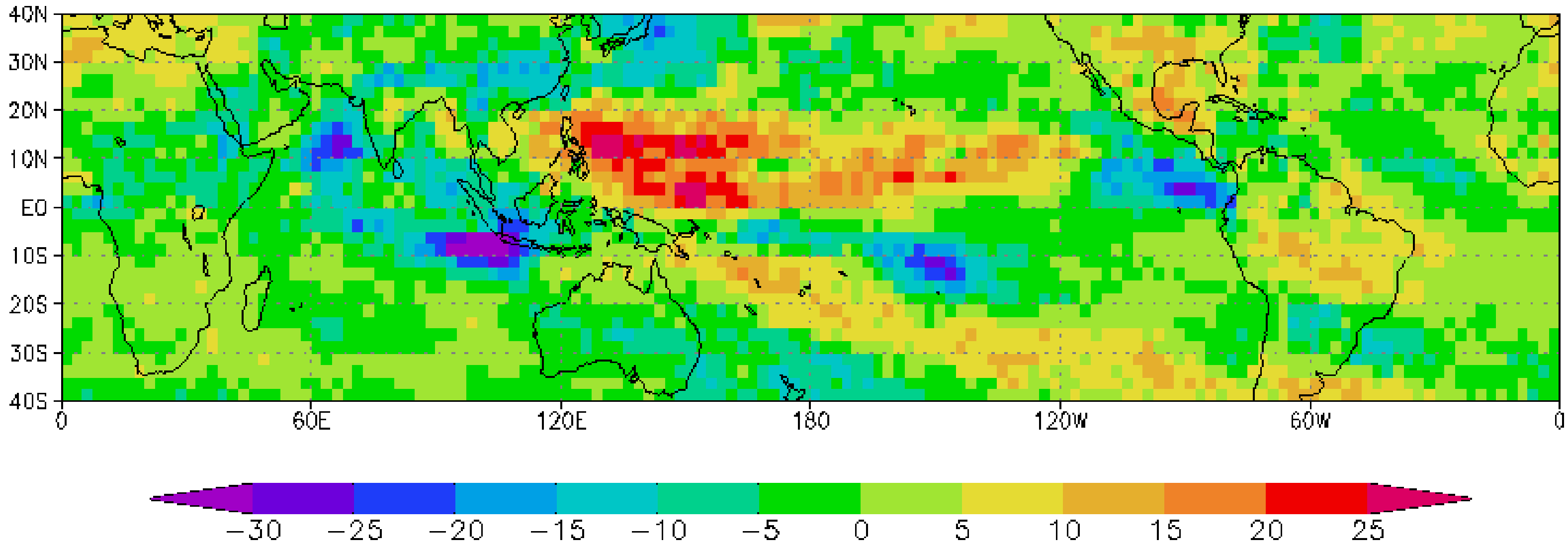
- Retrievals at locations with large *observed* SST anomalies biased toward climo SST retrievals; associated biases in clds, water vapor, OLR etc. still unknown.

JJA 1998 OLR Anoms (Wm^{-2})

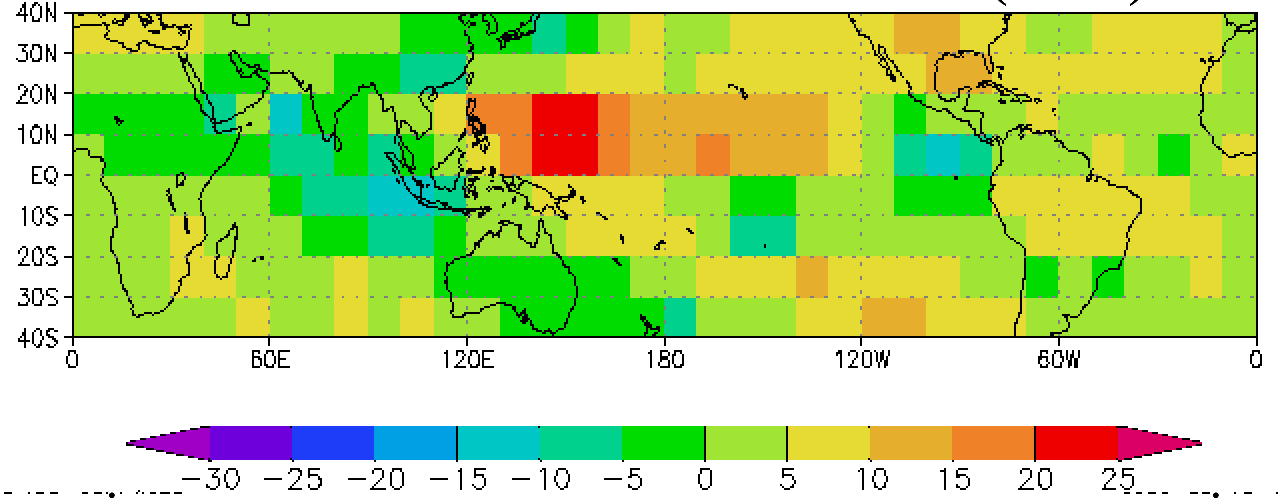
CERES



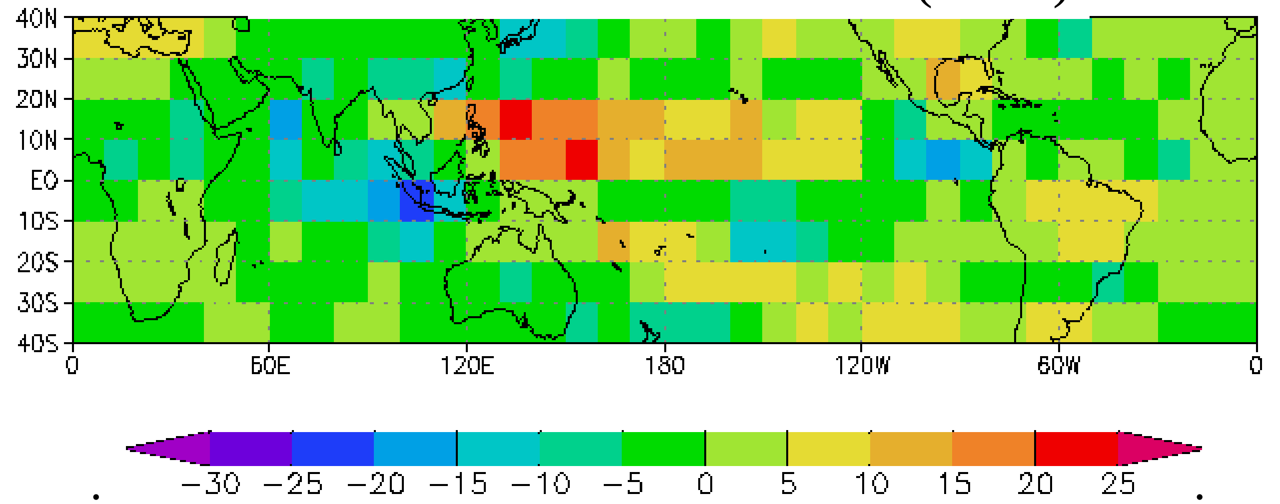
TOVS PathA



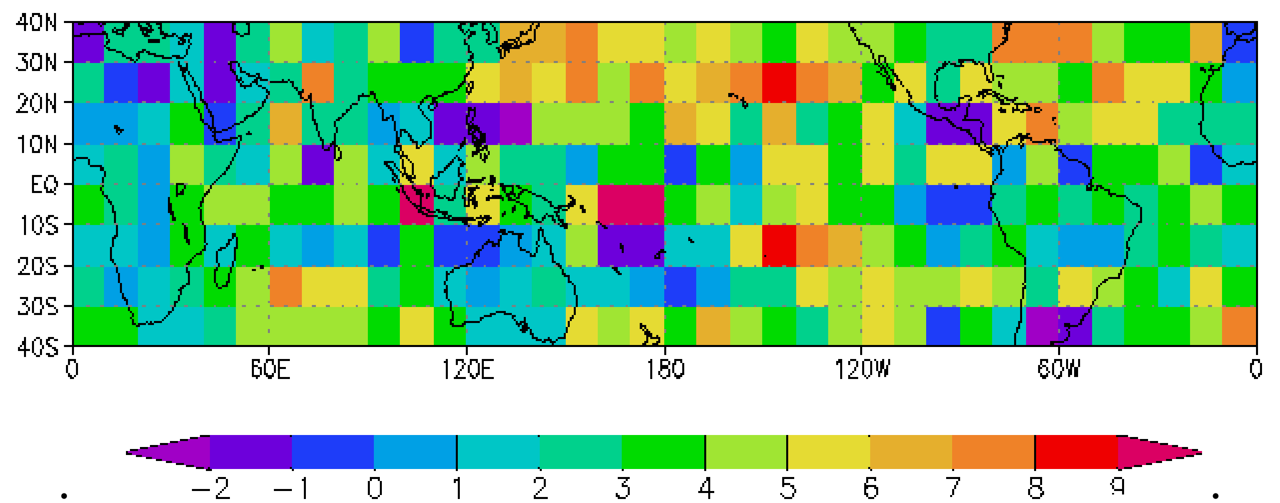
ERBS WFOV JJA 1998 OLR Anoms (Wm^{-2})



PathA JJA 1998 OLR Anoms (Wm^{-2})

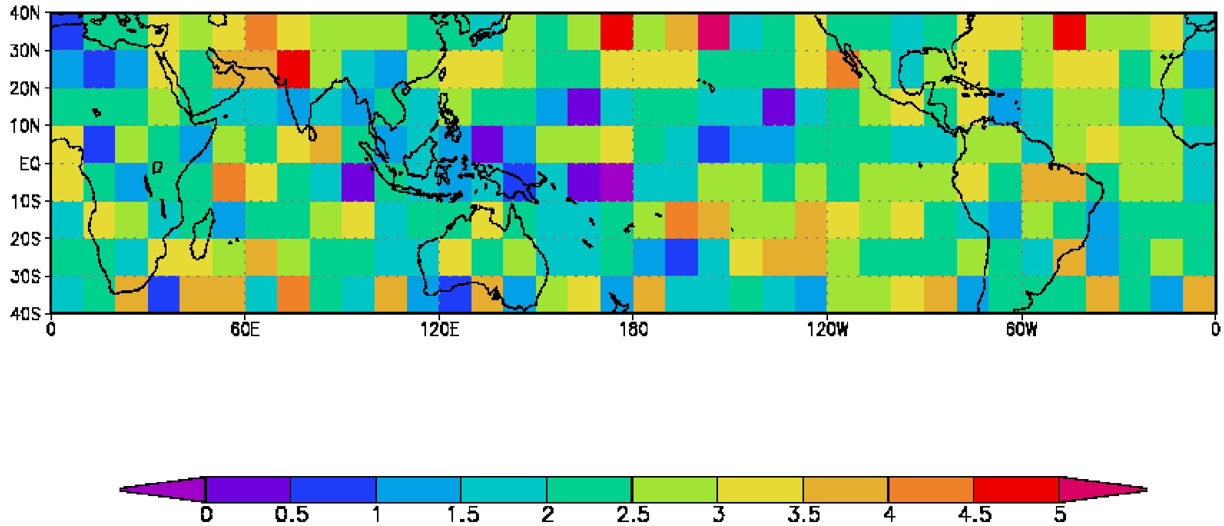


WFOV - PathA

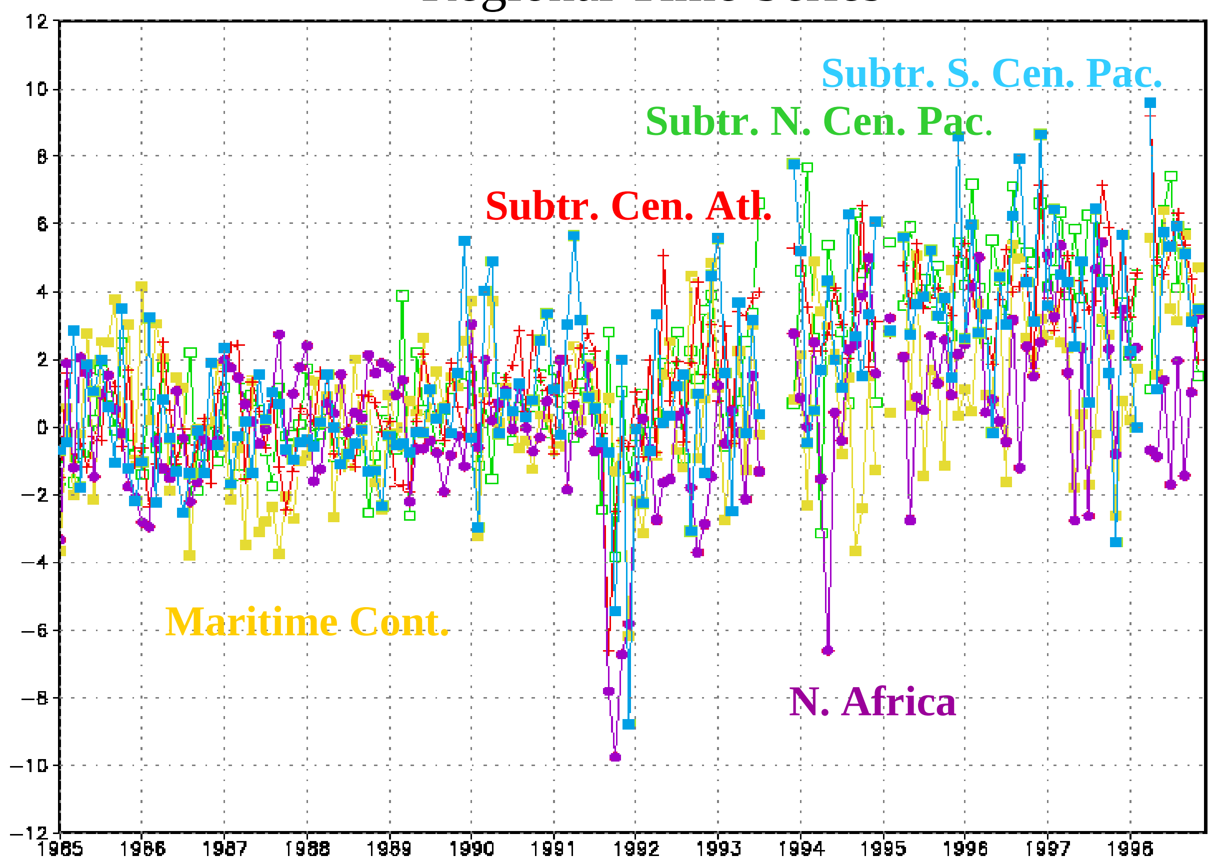


WFOV- PathA Differences (Wm^{-2})

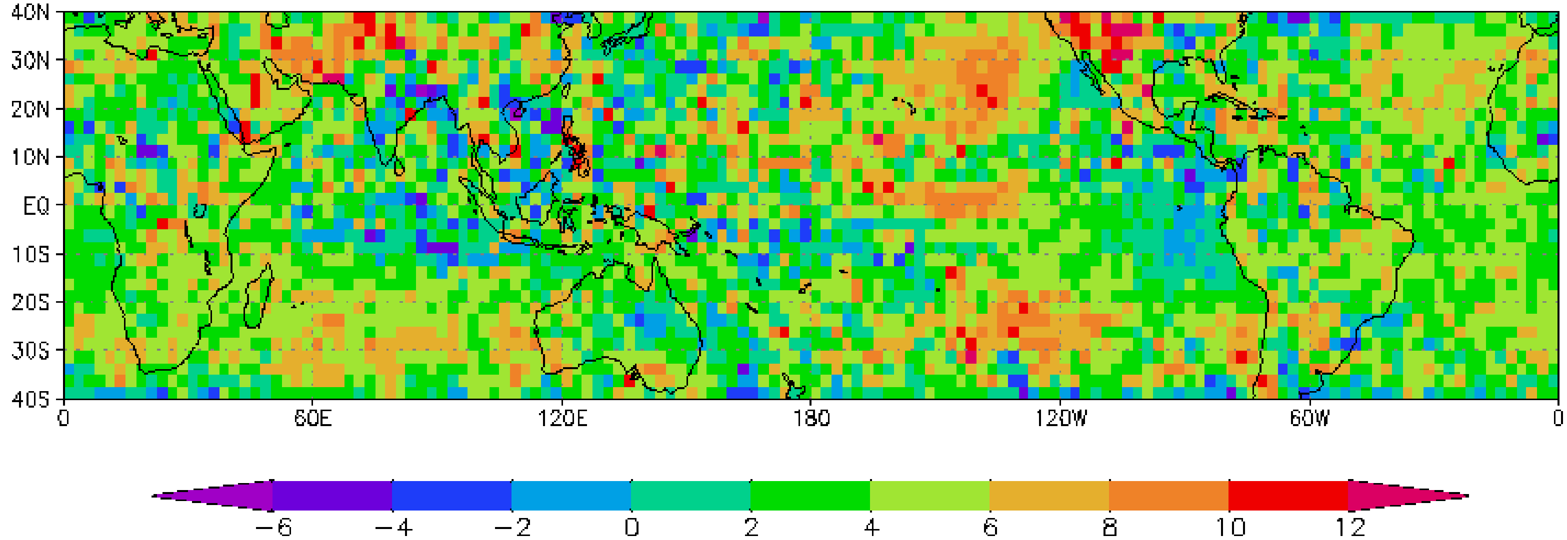
1993/96 Avg - 1985/92 Avg



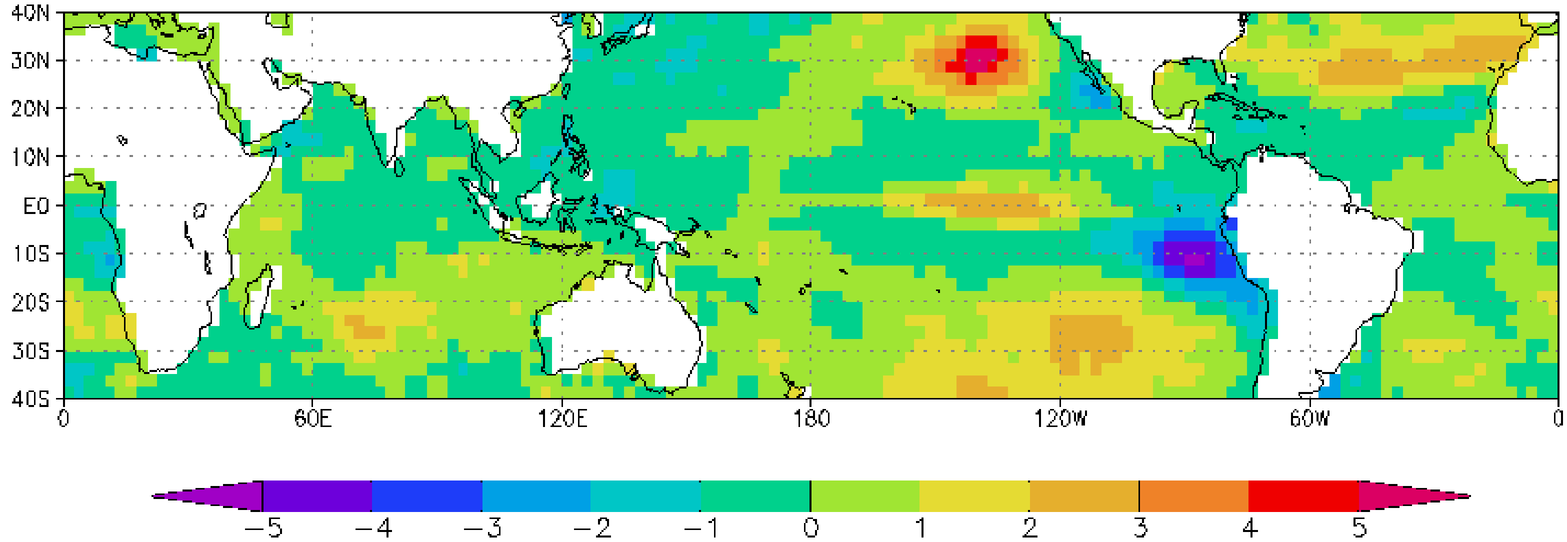
Regional Time Series



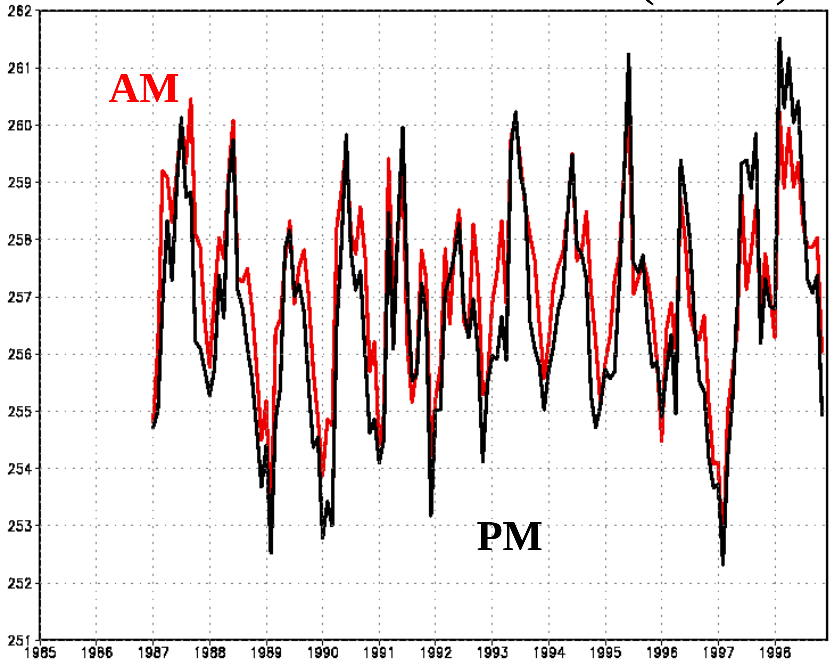
CERES minus PathA OLR Anoms (Wm^{-2}) JJA 1998



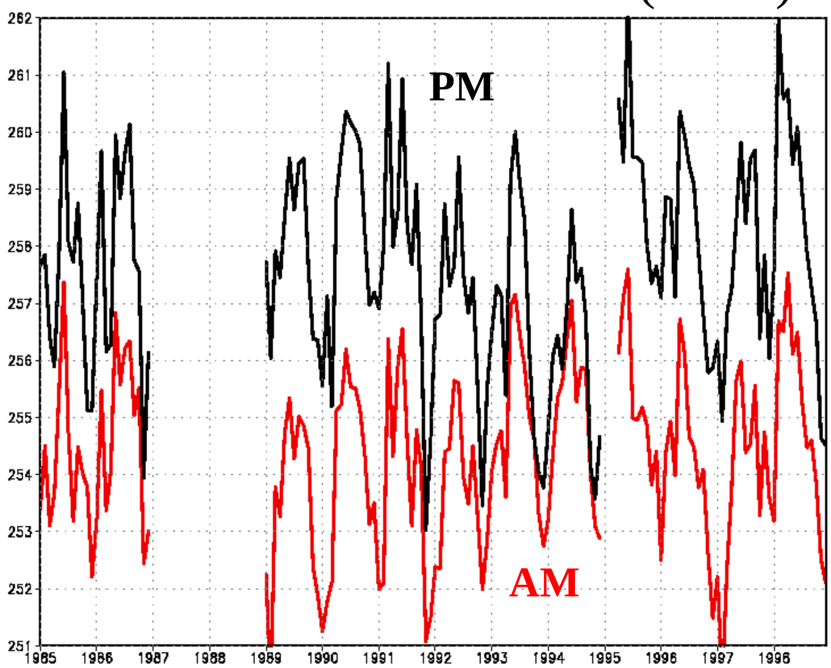
NCEP 850 mb T minus Reynolds SST Anoms (K) JJA 1998



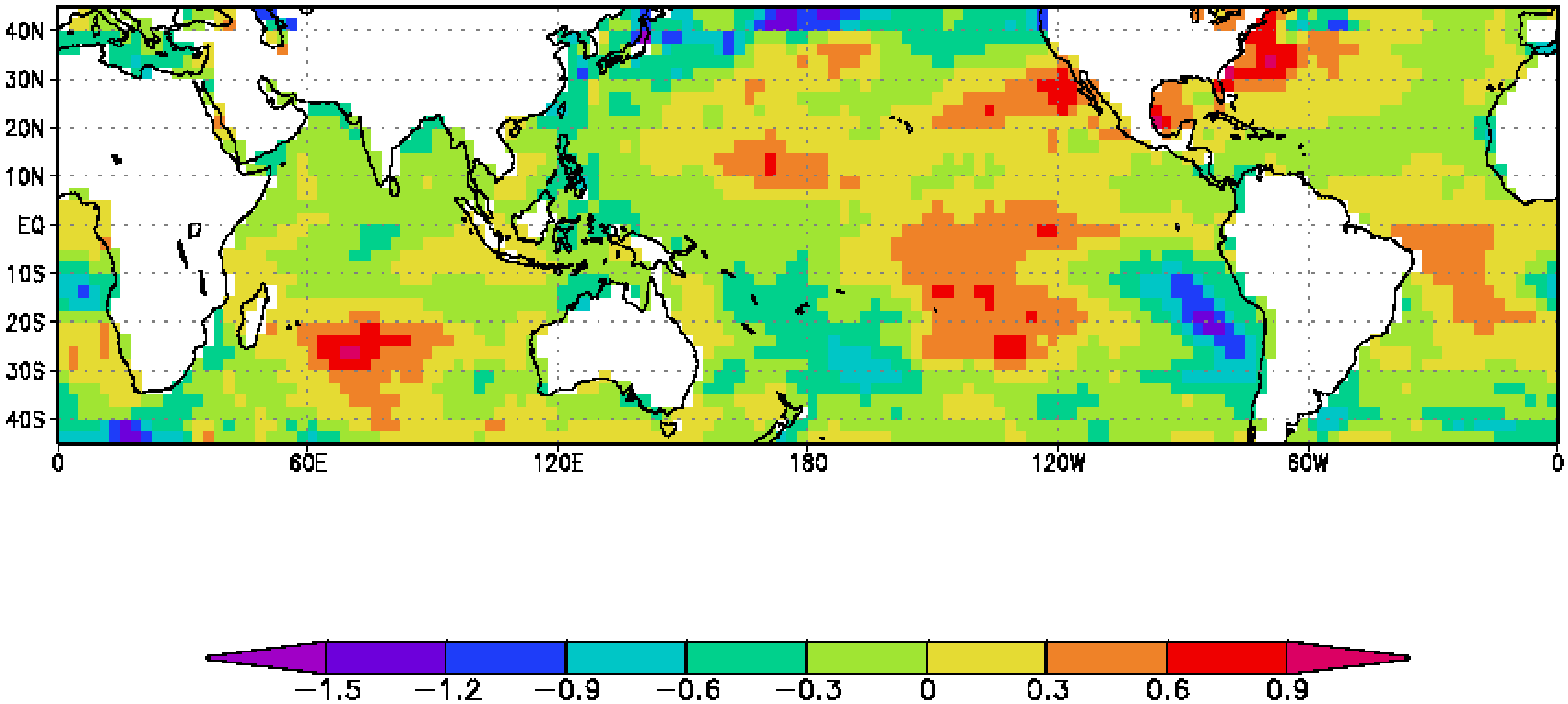
NOAA 7:30 Path-A OLR (Wm^{-2})



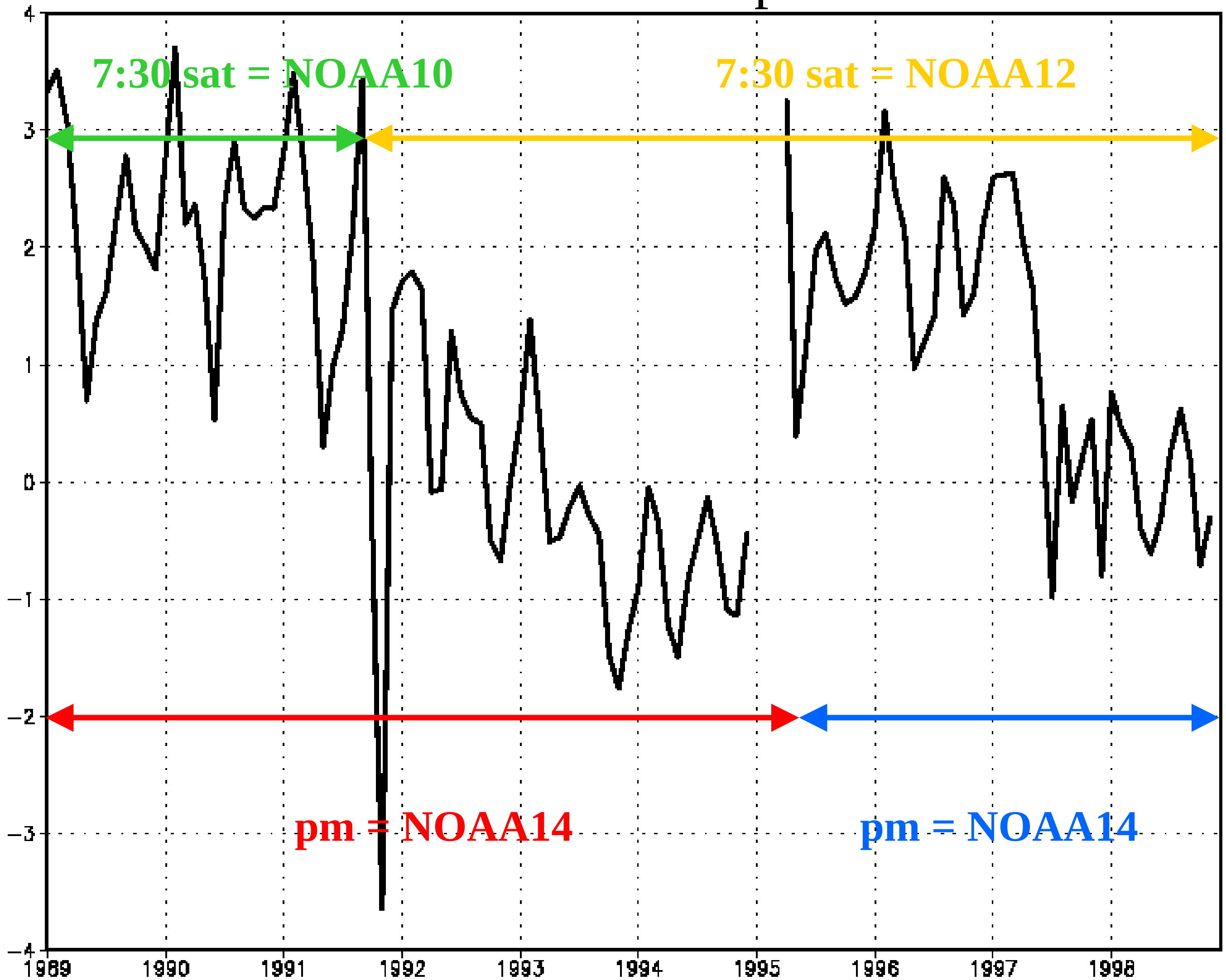
NOAA 2:30 Path-A OLR (Wm^{-2})



NCEP 850 mb T minus Reynolds SST (K)
1993/96 minus 1985/92

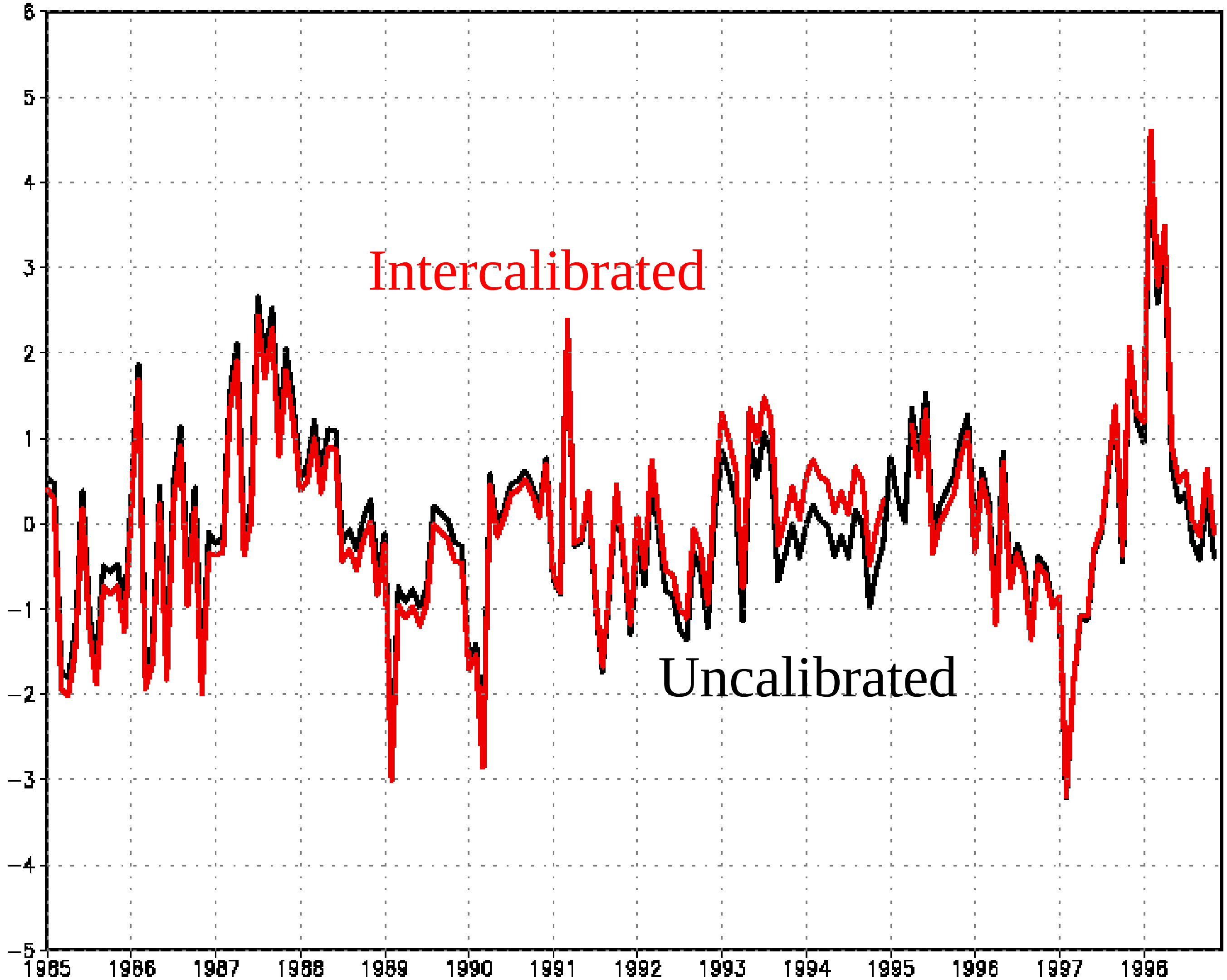


20^{o}N/S Mean OLR Differences (Wm^{-2})
7:30 satellite minus 2:30 p.m. satellite



Effects of PathA Satellite OLR Intercalibration

Flux Anoms (Wm^{-2}) 20^{o}N/S Avg

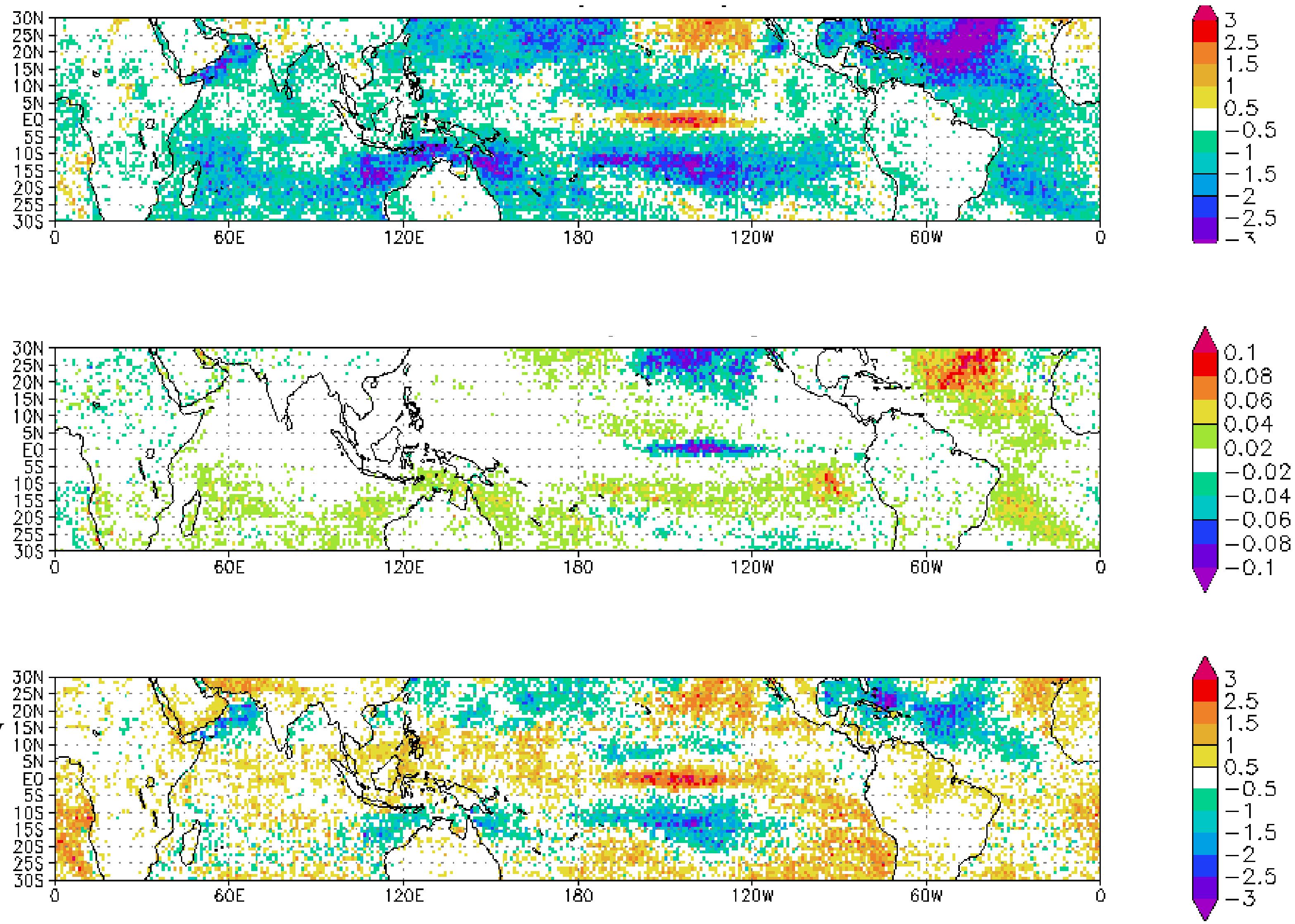


Fixed SST Retrieval minus Original PathA JJA 1998

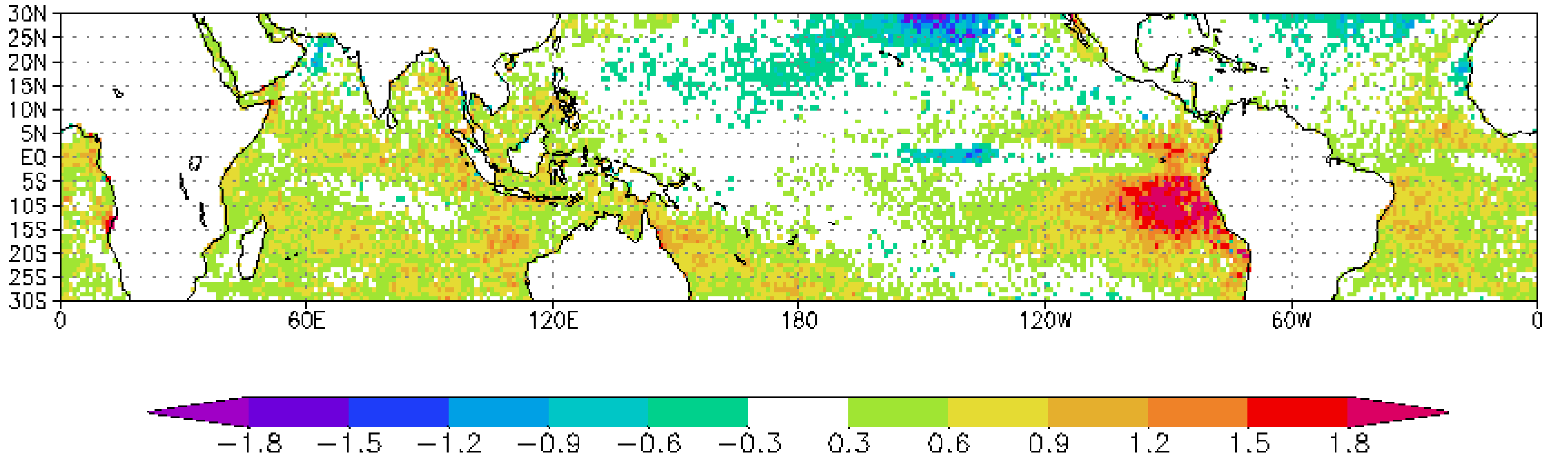
OLR (Wm^{-2})

Total Cloud Fraction (% x .01)

Clear-Sky OLR (Wm^{-2})

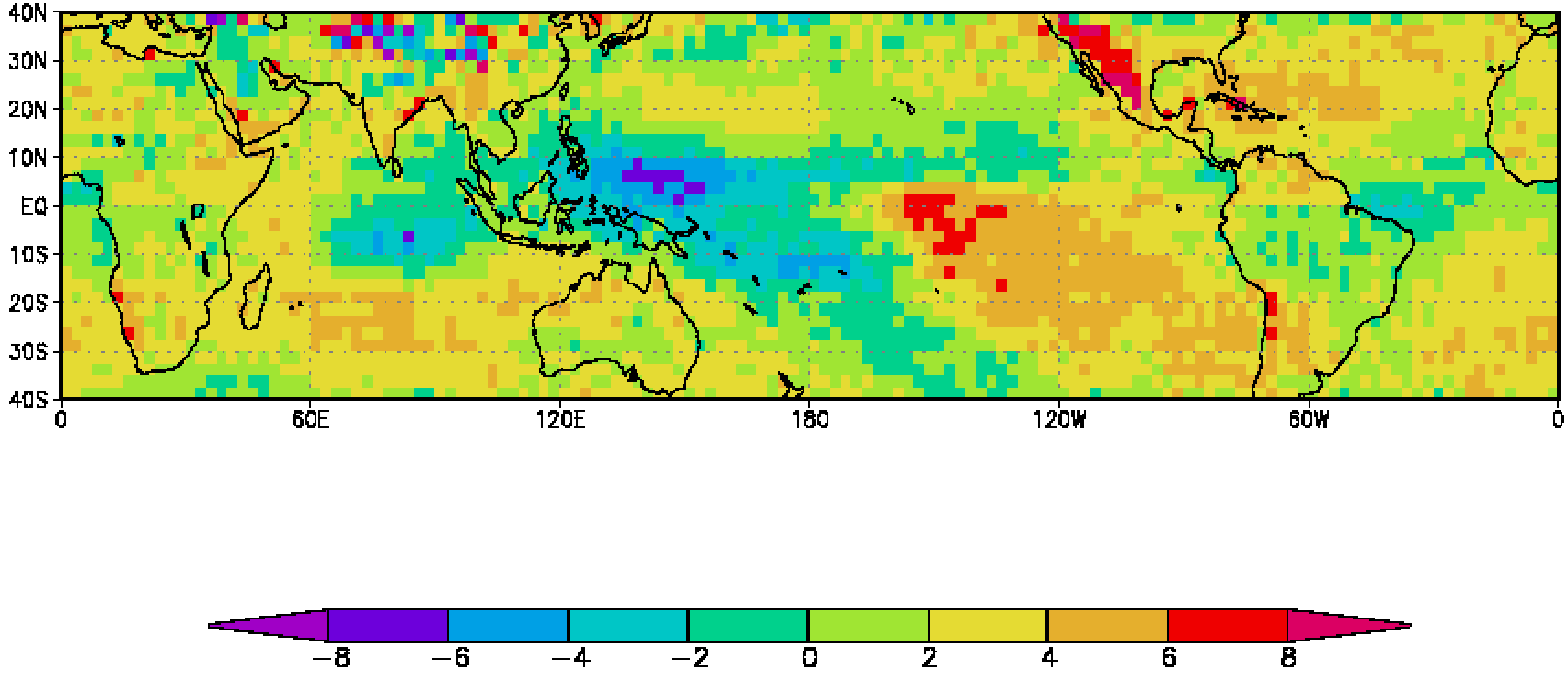


Fixed SST Retrieval minus Original PathA JJA 1998



SST Changes (K)

JJA 1998 LW Clear-Sky PathA - CERES (Wm^{-2})



SYNTHESIS:

While Path-A captures detailed spatial structure and integrated signal of interannual fluctuations in total OLR, its long-term rise is weaker by ~3.5 Wm^{-2} than the scanner and non-scanner records.

LWCS variability is in better agreement, but still is somewhat weak compared to CERES (1.0 vs. 2.3 Wm^{-2} increase between ERBS and CERES era).

Intercalibration of fluxes, though important, is difficult to invoke as a culprit. Emerging candidate explanations: (i) restrictive SST retrieval assumptions, (ii) interactions between low-level static stability and cloud retrieval shortcomings, (iii) cloud particle size changes, (iv) O3 data set revisions, CO2 changes.

PathA LW Clear-Sky fluxes vary from ERBS / CERES in expected ways in response to conditional sampling. (Type I vs type II LWCS)